Developing Rich Web GIS Applications for Visual Analytics

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Abstract. The development of Rich Internet Application tools and web mapping services, coupled with the dissemination of detailed, up-to-date socioeconomic data, present an opportunity to develop intuitive geospatial visual analytic tools. This paper presents our efforts at developing such tools that combine Google Maps, Flex, and data from the American Community Survey.

Keywords: Rich Internet Applications, Visual Analytics, American Community Survey, Google, Flex, KML.

1 Introduction

The world of internet GIS continues to evolve at an almost dizzying pace. Advances continue to be made in areas of development environments, web mapping services, and data availability. Indeed, data sources now include real time data from sensor networks [1], volunteered data, e.g., [2], and increasingly timely government data, such as the American Community Survey [3]. These tools and data advances give us the opportunity to develop new approaches for providing data analysis capabilities to literally anyone with internet access. Whether this is referred to as Web GIS or Geospatial Visual Analytics [4] these approaches allow us to develop web applications that let users retrieve data, visualize them in graphic, cartographic, and tabular formats, and interact with those formats in linked and synchronized ways. We now have the ability to develop Web GIS applications, some of which may employ statistical analysis methods, that support Exploratory Data Analysis as championed by Tukey [5]. Such applications allow users to draw inferences based on their ability to construct multiple data visualizations and interact with those visualizations in an intuitive manner. Such applications allow “…the human to directly interact with the underpinning data to gain insight, draw conclusions, and ultimately make better decisions” [4]. In short, we seek to build web applications that facilitate the user interaction with the data without the software getting in the way [6].
This paper presents our efforts to develop such tools for exploring data made available by the United States Census Bureau. This is particularly timely because the Census Bureau has begun releasing detailed data from American Community Survey (ACS), a data series that will supply yearly updates of socioeconomic and demographic data for communities across the United States. This marks “…the beginning of annual estimates for small communities and neighborhoods throughout the country” [7]. Prior to the development of the ACS, detailed socioeconomic data for the United States was only collected once per decade. Not only will the information released be more current, after a few years there will be time series data for a host of social and economic information for those communities. While these data are now coming online, the tools for exploring are waiting to be developed by the academic community, state and local government organizations, and the private sector. Such tools will give various user communities the ability to explore this more up-to-date information for making policy decisions.

2 Development Considerations

There are several decisions to be made when developing geospatial visual analytic tools. For example, what types of data representation should be developed? What underlying mapping service should be used? What types of data interaction should be supported? How much control should the user have in determining how the data are retrieved and presented? How much processing should be done on client and how much on the server?

In addition to these basic design questions, decisions on which development tools to use must be made. There is no one best set of tools, and choices often reflect the developer’s experience and preferences. Current rich internet application (RIA) development is dominated by frameworks available in Flex, Silverlight, and to a lesser extent, JavaFX. Despite its capability, RIA drives few complex web applications compared to those developed with HTML, CSS, Javascript/AJAX, and, often, Flash or Silverlight plugins for video or simple animation. HTML5 extends standard HTML to provide a compliance standard for web graphics and video. Because it promises to be accessible in all major browsers and mobile hardware platforms, it is an important challenge to solutions using plugins and that consume higher client resources. The HTML5 video element is in full scale trial across the Internet, including as an opt-in trial on Google’s YouTube. The less prevalent HTML5 canvas element provides rendering of 2d shapes and bitmaps (http://www.w3.org/TR/html5/the-canvas-element.html#the-canvas-element). MIT has developed an open source dynamic vector mapping framework [8] that includes an extension of CSS called geographic style sheeting (GSS). Performance is slow on the current implementation of the canvas element, and HTML5, even in its final specification, will not provide the rich set of user interface tools in the form of data grids, charting, and navigation that currently are available in Flex and Silverlight. Therefore the adoption of HTML5 for high performance geospatial visualization is probably some years in the future.